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PATENT APPLICATION

Docket No.: NC 84,613

approval by his supervisor before the rejection could be withdrawn. By telephone interview of 07/18/2005, the Examiner informed Applicants' representative that his supervisor had overruled the Examiner as to the issue of motivation because Meger teaches processing applications, which includes deposition.

#### Claim Rejections – 35 U.S.C. § 103

Claims 1-3, 7-9, and 15 have been rejected under 35 U.S.C § 103(a) as allegedly unpatentable over Meger et al. (*Physics of Plasmas*) in view of Moseson et al. (US 3,393,142).

Claim 1 is directed to a plasma deposition system, comprising an electron beam source, magnetic means, a source location, and a substrate location. The electron beam source has a width much larger in dimension than its thickness and is capable of sustaining an electron beam having an average electron energy of at least about 1 keV in the presence of 10 mTorr of oxygen. The magnetic means is for confining the beam so as to produce a plasma sheet. The plasma sheet is of pre-determined width, length, thickness, and location and has an electron temperature of about 1.5 eV or lower. The source location is for a material source and comprises sputtering means, vaporization means, or both. The substrate location is for a substrate upon which material sputtered or evaporated from the source is deposited.

Moseson discloses a cathode sputtering apparatus. The apparatus includes a filament cathode and an anode held at a voltage difference of about 40 V (col. 5, line 15) to produce an electron sheet. The electron sheet produces a plasma between a target and a substrate.

In order to make a *prima facie* case of obviousness, there must be a motivation to combine the references. The Examiner stated that the motivation for utilizing the sputtering target, substrate location, and sputtering sources of Moseson is that it allows for reducing the energy requirement for sputtering operations (office action of 05/27/2005, page 6, lines 3-6). However, only Moseson is related to sputtering operations. No sputtering operations are disclosed in Meger. Thus, if any such motivation is found in Moseson, it only motivates one to use the sputtering target, source location, and sputtering sources with the disclosure of Moseson itself, not with Meger. This does not motivate one to combine the references.

There is no motivation to combine the references because Moseson teaches the desirability of reducing the energy requirements of sputtering operations (col. 1, lines 50-52). The energy required for sputtering would be minimized when the production of plasma is

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optimized. Indeed, Moseson teaches the desirability of a strong plasma (col. 3, lines 56-57). It is not obvious to use the e-beam of Meger for deposition because, for example, the higher energy electrons of Meger do not have an optimized ionization cross section for a given gas. The attached graph shows the ionization cross-sections as a function of electron beam energy. Low energy electrons, such as 40 eV in Moseson have a large ionization cross section and are thus very likely to collide with and ionize the gas. Increasing the energy to 1 keV decreases the ionization cross section and reduces the amount of plasma formed per length of electron travel. A nonobvious feature of the present invention is that electron energies above 1 keV in the presence of a magnetic field produce plasma more uniformly over longer beam lengths. Higher energy electrons are more likely to go a greater distance before ionizing the gas and less likely to have non-ionizing collisions or elastic collisions. The magnetic field limits scattering via collisions with the background gas and since less energy is lost to elastic collisions, ionization and thus plasma production is more uniform over the entire length of the beam. This advantage is not limited to gas pressure or type, including reactive gases. Nothing in the references suggests that this would be useful for sputtering or other deposition techniques. As there is no motivation to combine, a *prima facie* case of obviousness has not been made.

The Examiner's supervisor reportedly stated that motivation is present because Meger teaches processing applications, which includes deposition such as Moseson. However, a suggestion to use the beam of Meger for processing is not a suggestion to use the beam for sputtering. The term "processing" covers so many processes that it cannot be taken as suggesting any particular process.

The high energy electrons may also produce a different mix of ions and radicals (in molecular gases) than the low energy electrons of Moseson. For example, the attached article, Leonhardt et al., "Applications of Electron-Beam Generated Plasmas to Materials Processing," *IEEE Trans. Plasma Sci.*, 33(2), 783 (2005), shows that a high energy beam in nitrogen gas produces a high fraction of  $N^+$  ions relative to  $N_2^+$  ions (Fig. 2). At low energy, mostly  $N_2^+$  ions are expected.

Claims 2, 3, 7-9, and 15 depend from and contain all the limitations of claim 1 and are asserted to distinguish from the reference in the same manner as claim 1.

Claims 4, 5, and 10 have been rejected under 35 U.S.C § 103(a) as allegedly unpatentable

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over Meger in view of Moseson and further in view of Oda et al. (US 3,436,332).

Oda discloses a sputtering apparatus using a filament cathode. The anode to cathode voltage is 60-100 V (col. 2, lines 55-56).

Claims 4, 5, and 10 depend from and contain all the limitations of claim 1 and are asserted to distinguish from the references in at least the same manner as claim 1, in that there is no motivation to combine Meger and Moseson.

Further, the Examiner stated that the motivation for biasing the substrate as in Oda is that it prevents electrons from entering the electron tube guide 16 (col. 3, lines 15-18). This statement from Oda is not understood, as there is no reference number 16 found in the drawings, so the location of the tube cannot be determined. Regardless of what the tube refers to, the bias referred to is not applied to the substrate. It is generated by power supply 24, which is applied to the filament 11, not the substrate 51.

Claims 6 and 12 have been rejected under 35 U.S.C § 103(a) as allegedly unpatentable over Meger in view of Moseson and further in view of Hurwitt et al. (US 6,416,635). Hurwitt discloses a sputtering apparatus where the target is moveable with respect to the substrate (abstract). The target is the source of both the electrons (i.e. the means to produce a plasma) and the sputtered material (col. 1, lines 13-29).

Claims 6 and 12 depend from and contain all the limitations of claim 1 and are asserted to distinguish from the references in at least the same manner as claim 1, in that there is no motivation to combine Meger and Moseson.

Claims 13 and 14 have been rejected under 35 U.S.C § 103(a) as allegedly unpatentable over Meger in view of Moseson and further in view of Bunshah et al. (US 4,336,277). Bunshah discloses a physical vapor deposition system using a filament in a very low concentration of oxygen.

Claims 13 and 14 depend from and contain all the limitations of claim 1 and are asserted to distinguish from the references in at least the same manner as claim 1, in that there is no motivation to combine Meger and Moseson.

In view of the foregoing, it is submitted that the application is now in condition for

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allowance.

In the event that a fee is required, please charge the fee to Deposit Account No. 50-0281,  
and in the event that there is a credit due, please credit Deposit Account No. 50-0281.

Respectfully submitted,



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